<u>What is claimed is:</u>

1. A method of designing a customized filter having nearly ideal responses in both gain and phase or gain and time, by utilizing poles derived from known standard sets of poles wherein the known standard sets of poles being chosen to define a frequency domain and a time domain by proportionally migrating at least one set of complex poles from a first location to a second location comprising the steps of:

choosing a set of complex frequency poles from said first location and said second location when a desired passband phase of the filter is linear while preserving the desired magnitude response;

normalizing said set of complex frequency poles from said first location and said second location to obtain a new proportional complex pole constellation;

multiplying said first and second set of complex frequency poles by predetermined weighting factors to calculate a hybrid first constellation and a hybrid second constellation; and

renormalizing the hybrid first constellation and the hybrid second constellation so as to obtain a proportionally migrated complex pole constellation to said second location.

2. The method of claim 1, wherein said step of choosing said set of complex frequency poles from said first location and said second location, comprises choosing a pair of normalized set of poles

$$C_n = = -c_1' + jc_1''$$

and

$$B_n = -b_1' + jb_1''$$

when C_n and B_n comprises a first and second normalized set of poles c_n

and b_n , and wherein the step of multiplying comprises multiplying the end-point number of poles by x and y, where x and y are weighting numbers,
and where the step of normalizing comprises dividing the sum of the weighted poles by x and y according to the equation

$$\frac{x(-c_1' + jc_1'') + y(-b_1' + jb_1'')}{x + y}$$

so as to migrate, wherein if x > y, then the new pole being closer to the first location; and if x < y, then the new pole being closer to the second location.

3. The method of claim 2, wherein C_n comprises a Chebychev constellation of complex frequency poles and B_n comprises a Bessel constellation of complex frequency poles, and the first location comprises a Chebychev location and the second location comprises a Bessel location.

4. The method of claim 1, wherein an arrangement of poles being calculated having graded characteristics between two of the extremes which is controlled by a choice of x and y.

5. The method of claim 1, wherein the constellation being closer to the imaginary axis being chosen to be anywhere between a Butterworth set and a high-ripple Chebychev set; and the left-most set of poles being a synchronously tuned or a Gaussian constellation or other linear phase or low time transient constellation.

6. The method of claim 1, wherein said hybrid model achieves 60 dB at about 2.2 times the passband edge.

7. The method of claim 1, wherein the phase response of the hybrid filter being more linear than that of the Chebychev filter, and having a phase deviation less than the phase deviation of the Chebychev.

8. The method of claim 1, wherein the method includes the step of:

varying X and Y until a computed stopband gain and a passband phase both meet system requirements.

9. The method of claim 7, wherein the method includes the steps of:

obtaining a favorable response combination of gain and phase or gain and time response, and

using the normalized pole locations to design a vast array of filters.

10. The method of claim 8, further comprising the steps of:

using simple transformations to frequency scale a low pass filter to any bandwith, and

using other transformations to convert to bandpass filters.

11. The method of claim 8, further comprising the steps of:

transforming poles to bandpass clusters; and

using direct synthesis computer programs.

12. A method of designing an n^{th} order filter by initially selecting known values for each element of said filter, said known values being selected from a relatively high selectivity type filter value as a first extreme value and a linear phase or time domain filter value as a second extreme value, said first extreme value being defined as a first set of numbers forming a first set of poles on a complex frequency plane, and said second extreme value being defined as a second set of numbers forming a second set of poles on said complex frequency plane, and a first constellation defined by a plurality of said first set of poles and a second constellation being defined by a plurality of said second set of poles, said method comprising the steps of:

choosing at least one first set of complex frequency poles in a complex frequency plane to form a first constellation based on the extreme characteristics of the filter, and at least one second set of complex frequency poles in the complex frequency plane to form a second constellation based on the extreme characteristics of the filter so that a desired passband phase of the filter is linear while preserving the desired magnitude;

normalizing a set of complex frequency poles to obtain a proportional complex pole constellation;

multiplying the proportional complex pole constellation by weighting factors; and

renormalizing a resulting complex pole constellation to obtain a hybrid arrangement of pole constellations having graded characteristics between the first and second constellations.

13. The method of claim 12 wherein the relatively high selectivity filter value is selected from a Chebychev filter value.

14. The method of claim 12 wherein the linear phase or time domain filter value is selected from a Bessel filter value.

15. The method of claim 12 wherein the relatively high selectivity filter value is selected from a Chebychev filter value and wherein the linear phase or time domain filter value is selected from a Bessel filter value.